# HIGHWAY POLICIES AND PROCEDURES MANUAL

**Maryland Department of Transportation**
**STATE HIGHWAY ADMINISTRATION**
**Office of Highway Development**
**Highway Design Division**

Director, Highway Development

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| **Chapter** | DESIGN | **Ref. No**.: D-89-07AL(H) |
| **Section** | ALIGNMENT (HORIZONTAL) | **Effective:** |
| **Subject** | GUIDELINES FOR USE OF SUPERELEVATION | **Sheet:** 1 **of** 4 |

**Application:** ☒ DESIGN
☒ CONSULTANT ENGINEERING
HYDRAULICS
☒ ENGINEERING SUPPORT
ADMINISTRATION
OTHER

**Directive**: The following design procedures shall be used for selecting the horizontal alignment and applying superelevation rates.

1. In selecting the radius of curvature for the original alignment of a new OPEN SECTION facility, the minimum radius of curvature should be based upon the criteria contained in the $^{e}$max chart of 0.06 found in the 2001 AASHTO "*POLICY ON GEOMETRIC DESIGN OF HIGHWAYS AND STREETS*," page 159.

2. When applying the superelevation to an alignment, the $^{e}$max of 0.08 is to be used for the design of expressway mainlines while all other open section facilities will utilize the $^{e}$max of 0.06 (refer to 2001 AASHTO pages 161 and 159, respectively).

3. New CLOSED SECTION urban facilities should be based upon the $^{e}$max chart of 0.04 found on page 157 of 2001 AASHTO.

4. On interchange loop design (both entrance and exit loops) the preferred alignment is established utilizing the $^{e}$max of 0.08 criteria. As these loops are generally designed for low speed (30 mph), when Right-of-Way or other cost constraints exist, these inner loops may use the $^{e}$max of 0.10 criteria in establishing the control radius (refer to page 163, 2001 AASHTO). The use of 0.10 superelevation for the extreme Western Maryland counties (District 6) is discouraged. Due to climatic conditions, the maximum superelevation used in those areas should be 8.0%.

5. On interchange outer ramp design, including directional movements, generally designed for 50 mph or greater, the mainline $^{e}$max rate should be utilized with a maximum allowable rate of 8.0%.

6. For at-grade intersection design utilizing channelized free flow right turn ramp movements, the criteria established in Exhibit 3-43 should be utilized (refer to page 201, 2001 AASHTO). At signalized intersections, minimum AASHTO rates should be utilized on the mainline to minimize or avoid adverse slopes (bumps) through the intersection, due to superelevation on the intersecting roadway.

7. Superelevation Transition Lengths

   To transition from a normal section to a superelevated section, use the following formula:

   $$T.L. = \frac{\text{Total Change in Pavement Cross Slope}}{\text{"C"}}$$

   Where

   T.L. = transition length to get from the last normal section to the first fully superelevated section.

   "C" = rate of change in pavement cross slope, per foot of longitudinal length, in the transition area.

   "C" Factor criteria is established as follows:

| "C" Factor | Improvement Type |
|---|---|
| .0001 | Expressways and Urban Highways |
| .00015 | Other Highways |
| .0002 | Directional Ramps and other two-lane ramps |
| .0003 | Single-lane outer ramp |
| .0004 | Inner loops |

8. Location of superelevation transition with respect to the horizontal curve.

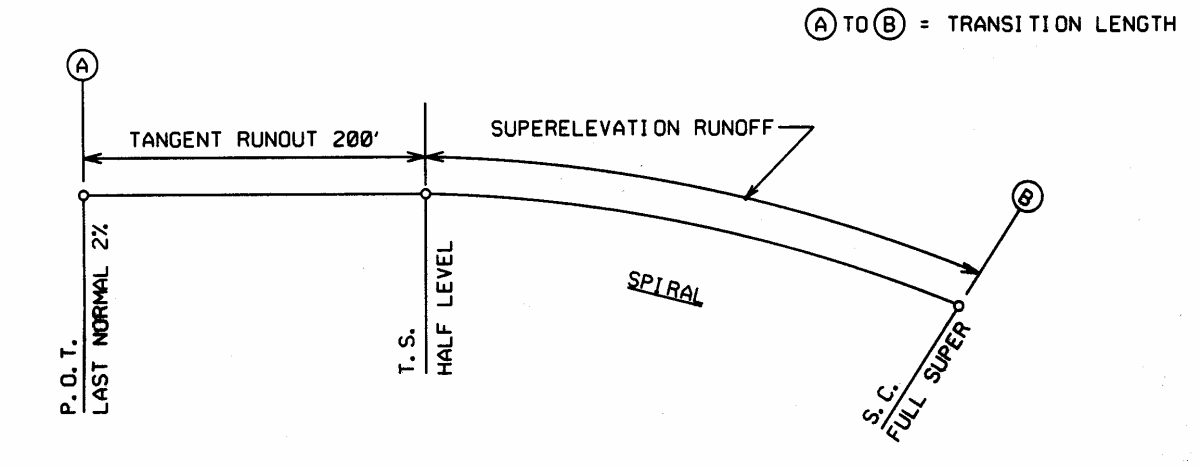
   The Administration uses the following distribution of the superelevation transition to the alignment:

   a. **Simple Curve.** Generally used on all but selected expressways 1/3 of the transition length into the curve (ahead of PC) and 2/3 of the transition length on the tangent (behind the PC). This application also applies coming out of a curve with respect to the PT.

b. **Spirals.** Where spirals are utilized on selected expressway facilities, the spiral should equal the length of the superelevation runoff. This is the length from the "half level" section to the "full superelevated" section. The TS would be the "half level" section while the SC would be the first "full super" section and the reverse coming out of the spiral. The tangent runout is the length required to accomplish the change in cross slope from normal section to "half level" section. The summation of these two lengths is the "transition length." As spirals are generally only used in the design of expressways, and with the application of the .0001 "C" factor to the formula

$$\text{T.L.} = \frac{\text{x-slope change}}{\text{"C"}},$$

The following applies:




Length of Spiral = Super Rate divided by "C" Factor

when S = 0.08 use a 800 ft spiral
when S = 0.06 use a 600 ft spiral
etc.

9. Minimum Tangent Length Between Reversing Curves on Mainline Alignment.

   When establishing the original alignment of a new facility, the use of reverse curves shall be avoided. Reversing curves shall be sufficiently separated to provide distance to obtain appropriate superelevation runoff of each curve.

   In general, the minimum tangent between reversing curves should be the summation of the 2/3 distance computed for each curve. A minimum distance of 500 ft is generally preferred on alignments other than expressways.

10. Minimum Tangent Length Between Reversing Curves on Ramp Alignments.

    When establishing the original alignment of outer ramps, the use of reversing curves is discouraged. Reversing curves shall be sufficiently separated to provide distance to obtain appropriate superelevation runoff of each curve.

    Where interchange design is constrained by environmental concerns, abutting development (excessive right-of-way costs and/or construction costs), the use of wrap-around outer ramp alignments are sometimes required. In these special cases, attention to the alignment is necessary. The superelevation considered shall be obtained from the $e_{max}$ chart of 0.06, to minimize the required transition length.

    If reversing curves must be used, the reversing superelevation is accomplished by setting the level section (0.0%) at the P.R.C. and transition to and from this section using appropriate "C" factor.

11. Avoid the use of "broken-back" curves. The use of compound curves is preferred over short tangents between curves in the same direction.